limit current, and output transistors, respectively. Reference numerals 69-70, 71, and 72 denote discharging fixed resistors for detecting the residual voltage, fixed resistors for detecting the current, a fixed resistor for limiting current, respectively. Reference numerals 73, 74-75, and 76 denote a current-storing capacitor, a fixed resistor for adjusting an amplification factor, and a voltage amplifier, respectively.

The basic operations of the device according to the present invention will now be described with reference to the figures. When the power switch 57 is pressed, the microcomputer 59 is activated to start to give a drug to a subject under a procedure previously programmed. The microcomputer 59 causes the LED 56 to light up and then causes the transistor 61 to oscillate, thereby producing a voltage that is boosted from the voltage of the battery 54. When the transistor 61 oscillates, a back electromotive force is developed across the coil 60, the back electromotive force being stored in the capacitor 63 through the diode 62. When the microcomputer 59 controls the transistor 67 to conduct the transistor 68, the voltage held across the capacitor 63 is directed to the output terminal A.

When the transistor 68 is then turned off, a residual voltage appears on the output terminal A if a load has been connected to the output terminals. The residual voltage is divided by fixed resistors 69 and 70 and is then directed to the analog input terminal of the A/D converter in the

microcomputer 59. When the measured voltage has reached a predetermined value, the microcomputer 59 determines that the conduction state is normal. When the measured voltage has not reached the predetermined value, the microcomputer 59 determines that the conduction state is abnormal. If the conduction state is abnormal, then the microcomputer 59 causes the LED 56 to flash and the buzzer 58 to sound, thereby warning the operator. If the abnormal condition is not solved beyond a certain period of time, then the microcomputer 59 shuts off the output. Then, the microcomputer 59 causes the buzzer to sound and the LED to go off, thereby indicating to the user that the output has been interrupted. Performing these operations in sequence secures the safety of the user.

If a constant current means, which comprises circuit elements 71-76 to keep the current (current for giving a drug) flowing through the DC impedance to a predetermined value, is used as the output controlling means, an excess current is to be prevented from flowing through the load so that safety is improved. When the preparation comes off or floats from the applied part of the human body, a general iontophoresis apparatus may not only fail to give a sufficient amount of drug to the applied part but also cause concentration of current in areas still in intimate contact with it. This may result in excessive supply of drug in particular small areas and electric burn. In contrast to this, the iontophoresis apparatus according to the present invention electrically energizes the body while making sure that a reliable electrical

path is established for giving a drug. If an abnormal impedance should be detected, the apparatus warns the user, requesting of an improvement or interrupting the output, if necessary, to ensure safety of the user.

Examples

(Example 1)

A device for iontophoresis incorporates a detecting circuit for an output current as shown in FIG. 3, which used a rectangular wave having a frequency of 10 kHz and a duty cycle of 50% as an output voltage that was variable from 0 V to 10 V in increments of 2 V. The detection conditions were as follows. The current-detecting fixed resistor 8B was 1 kΩ. The current-storing capacitor 12 was 0.1 μF. The discharging fixed resistor 13 was 1 MΩ. The threshold level of the voltage comparator 10B was adjusted to 0.1 V. When the iontophoresis apparatus incorporating the aforementioned iontophoresis device was used, each of the positive and negative electrodes applied to the skin had an area of 5 cm^2.

(Example 2)

A structure of the device for iontophoresis of Example 2 is the same as that of Example 1, which used a rectangular wave having a frequency of 10 kHz and a duty cycle of 50 % as the output voltage that was adjusted to a 5 V. The detection conditions were as follows. The current-detecting fixed resistor 8B was 1 kΩ. The current-storing capacitor 12 was 0.1 μF. The discharge fixed resistor 13 was 1 MΩ. The threshold level of the voltage comparator 10B was adjusted